

Acids and Alkalis

Chapter 12

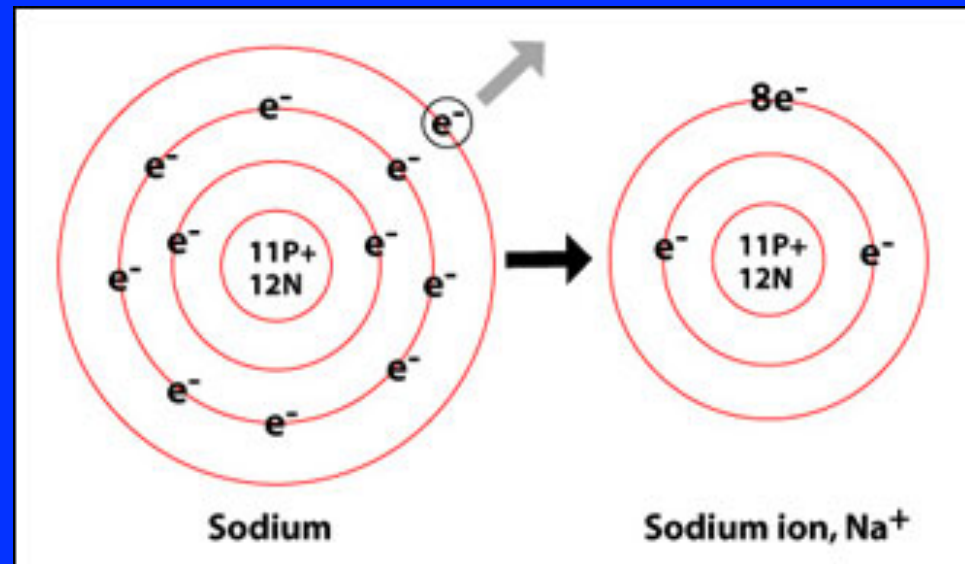
Ions

Do you remember what ions are?

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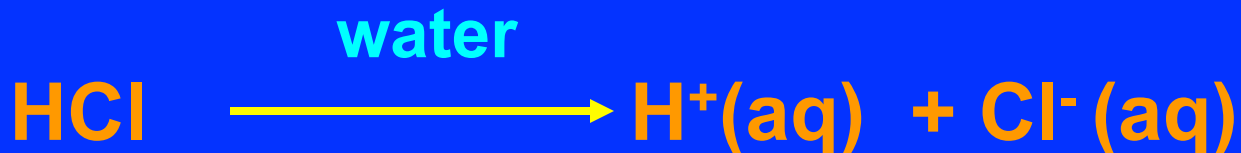
An ion is an atom that has lost or gained an electron giving it a positive (+) or negative (-) charge.



Acids and Bases

Arrhenius definition

- Acids produce H^+ in aqueous solutions



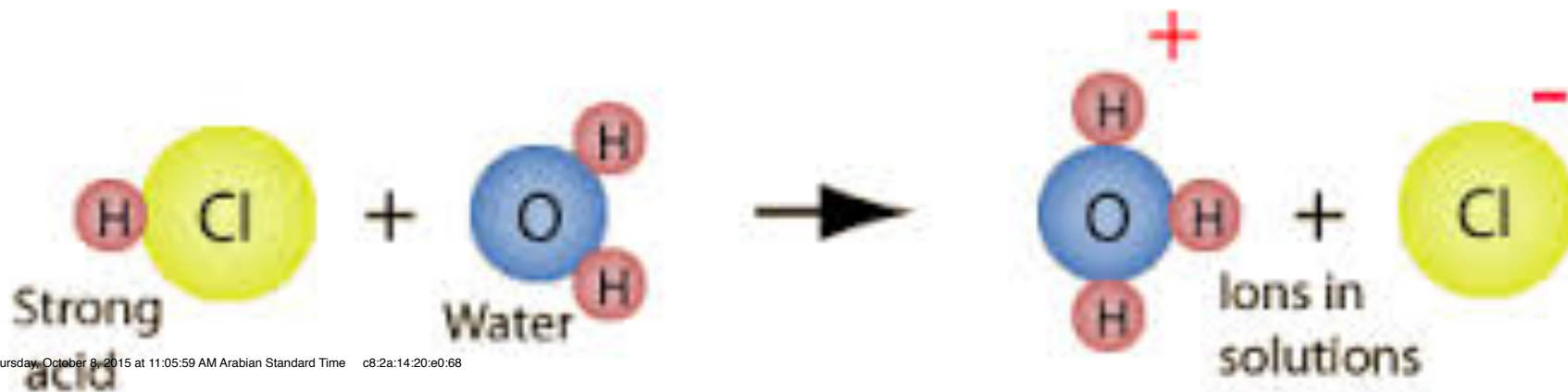
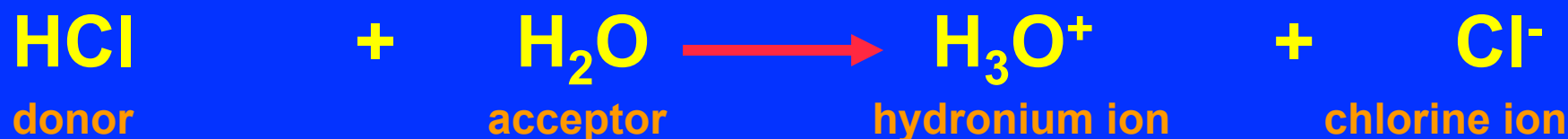
- Bases produce OH^- in aqueous solutions



Bronsted-Lowry Acids

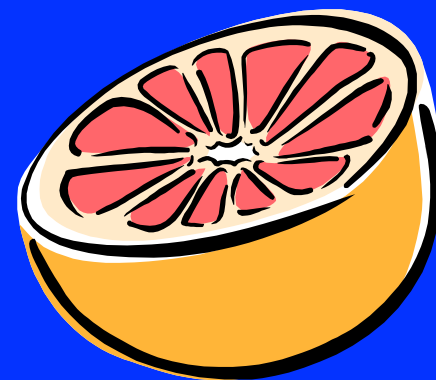
Acids are hydrogen ion (H^+) donors

Bases are hydrogen ion (H^+) acceptors



Acids

- Produce H^+ (as H_3O^+) ions in water
- Produce a negative ion (-) too
- Taste sour
- Corrode metals
- React with bases to form salts and water

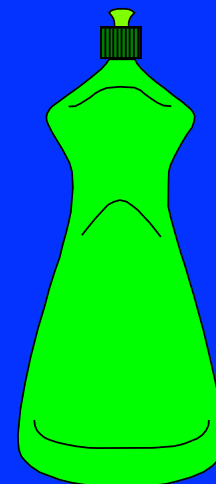


Uses of Acids

- Citric acid and ascorbic acid (Vitamin C) are found in orange juice
- Carbonic acid and phosphoric acid give a “bite” to soft drinks
- Acids in your stomach aid in digestion
- Sulfuric acid is the most widely used industrial acid in the world. It is used in making metals, paper, paints, and fertilizers.

Bases

- Produce OH^- ions in water
- Taste bitter, chalky
- Are electrolytes
- Feel soapy, slippery
- React with acids to form salts and water



Uses of Bases

- Bases are used in soaps (*remember, bases are slippery*)
- Bases are used to make paper, in oven cleaners, and to unclog drains
- Ammonia is a base and is used in many household cleaners

Learning Check AB1

Describe the solution in each of the following as: 1) acid 2) base or 3) neutral.

A. ____ soda

B. ____ soap

C. ____ coffee

D. ____ white vinegar

E. ____ water

F. ____ grapefruit

Solution AB1

Describe each solution as:

1) acid 2) base or 3) neutral.

A. 1 soda

B. 2 soap

C. 1 coffee

D. 1 white vinegar

E. 3 water

F. 1 grapefruit

Learning Check AB2

Identify each as characteristic of an **A) acid** or **B) base**

- _____ 1. Sour taste
- _____ 2. Produces OH^- in aqueous solutions
- _____ 3. Chalky taste
- _____ 4. Produces H^+ in aqueous solutions

Solution AB2

Identify each as a characteristic of an **A) acid** or **B) base**

A 1. Sour taste

B 2. Produces OH^- in aqueous solutions

B 3. Chalky taste

A 4. Produces H^+ in aqueous solutions

Some Common Acids



hydrochloric acid



nitric acid



phosphoric acid



sulfuric acid



acetic acid

Learning Check AB3

Give the names of the following

A. HBr (aq)

- 1. bromic acid**
- 2. bromous acid**
- 3. hydrobromic acid**

B. H_2CO_3

- 1. carbonic acid**
- 2. hydrocarbonic acid**
- 3. carbonous acid**

Solution AB3

A. HBr 3. hydrobromic acid

The name of a nonoxy acid begins with the prefix *hydro-* and ends with *-ic acid*. In a nonoxy acid, the negative anion end in *-ide*.

B. H_2CO_3 1. carbonic acid

The name of an oxyacid is named with the stem of the anion (*carbonate*) changed to *-ic acid*

Some Common Bases

NaOH

sodium hydroxide

KOH

potassium hydroxide

Ba(OH)₂

Mg(OH)₂

Al(OH)₃

aluminum hydroxide

Learning Check AB4

Match the formulas with the names:

- | | | |
|---------|-------------------------|----------------------|
| A. ____ | HNO_2 | 1) hydrochloric acid |
| B. ____ | Ca(OH)_2 | 2) sulfuric acid |
| C. ____ | H_2SO_4 | 3) sodium hydroxide |
| D. ____ | HCl | 4) nitrous acid |
| E. ____ | NaOH | 5) calcium hydroxide |

Solution AB4

Match the formulas with the names:

- A. 4 HNO_2 1) hydrochloric acid
- B. 5 Ca(OH)_2 2) sulfuric acid
- C. 2 H_2SO_4 3) sodium hydroxide
- D. 1 HCl 4) nitrous acid
- E. 3 NaOH 5) calcium hydroxide

pH

- Indicates the acidity $[\text{H}_3\text{O}^+]$ of the solution
- $\text{pH} = -\log [\text{H}_3\text{O}^+]$ → this will be covered in details later on.
- From the French *pouvoir hydrogene* (“hydrogen power” or power of hydrogen)

pH

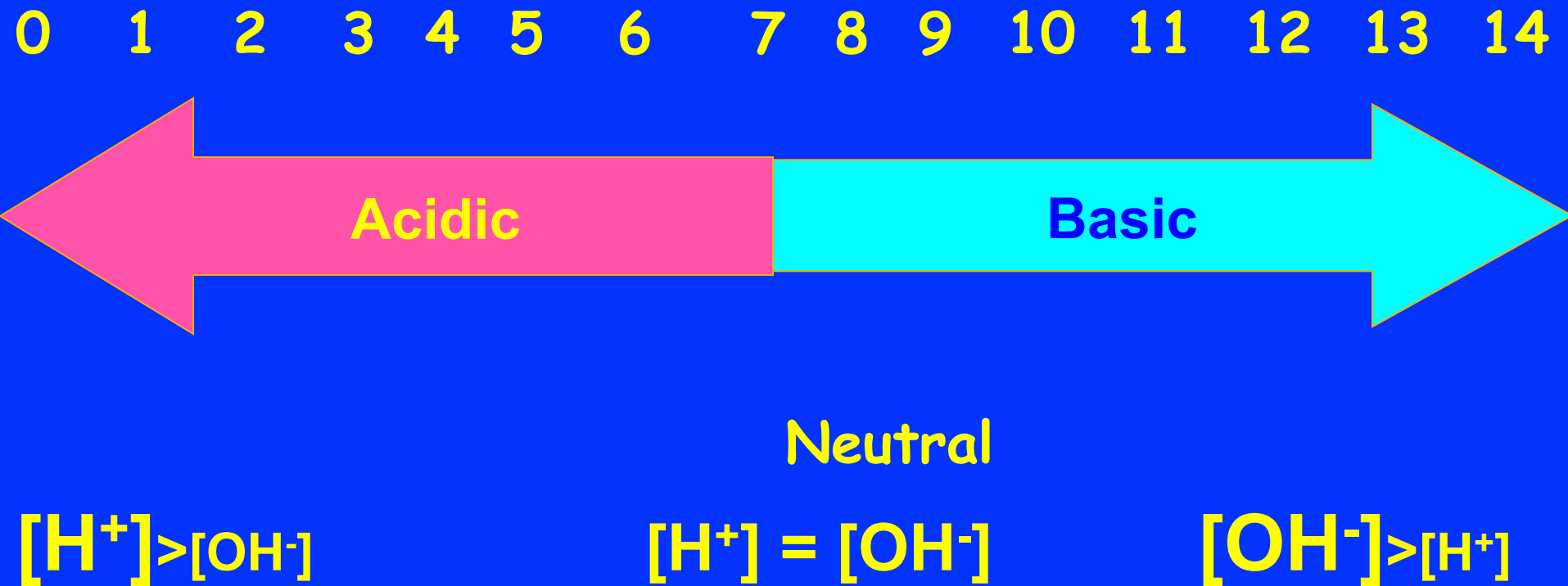
In the expression for $[\text{H}_3\text{O}^+]$

$1 \times 10^{-\text{exponent}}$

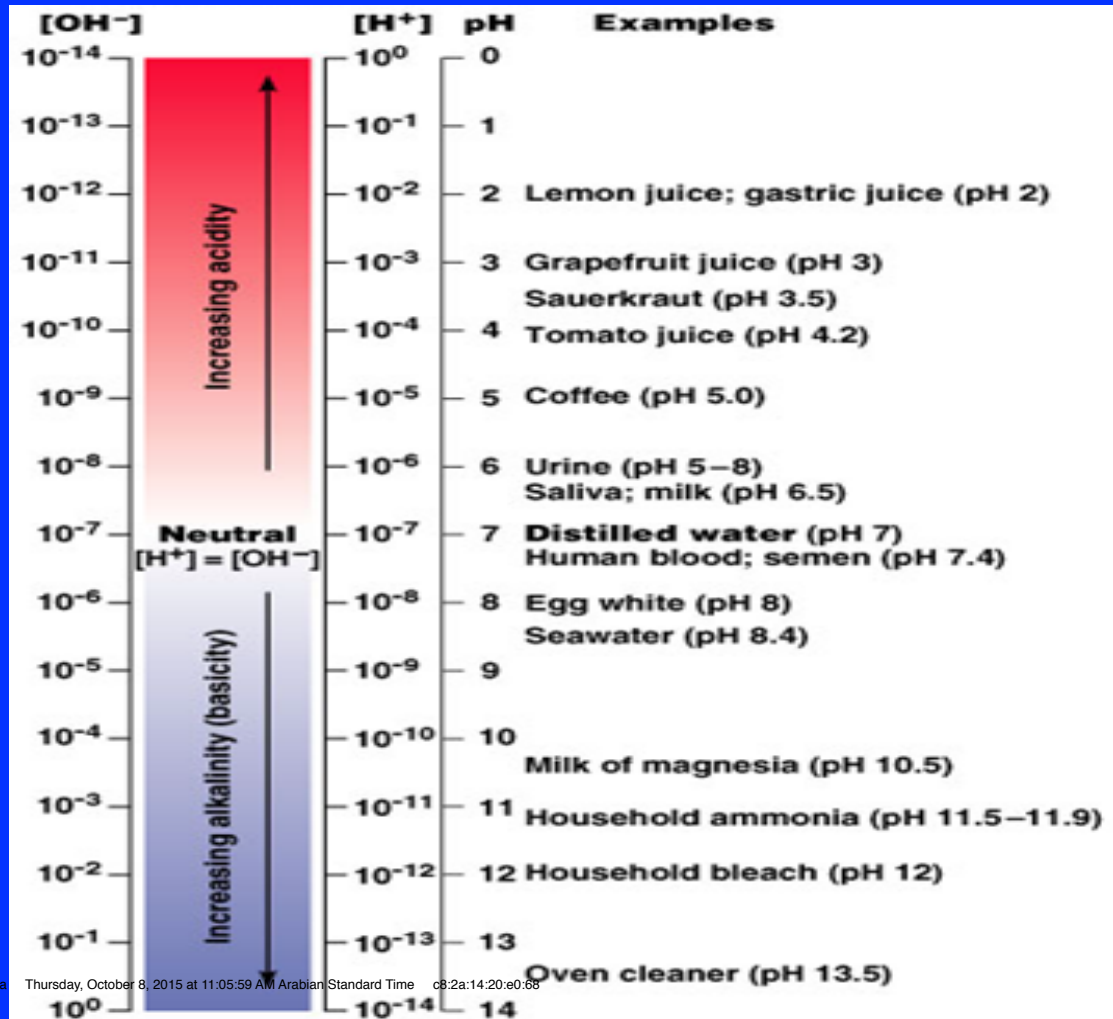
the exponent = pH



pH Range



pH Scale



- The higher the $[H]^+$ concentration,
 - the lower the pH,
 - the more acidic it is.

Some $[\text{H}_3\text{O}^+]$ and pH

$[\text{H}_3\text{O}^+]$

pH

$1 \times 10^{-5} \text{ M}$

5

$1 \times 10^{-9} \text{ M}$

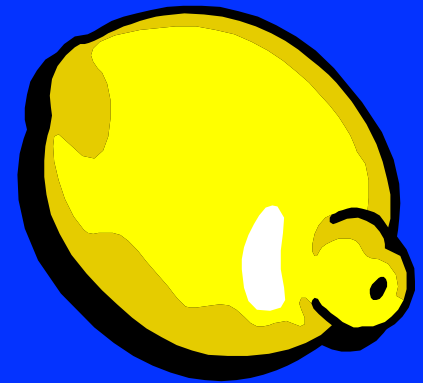
9

$1 \times 10^{-11} \text{ M}$

11

pH of Some Common Acids

gastric juice	1.0
lemon juice	2.3
vinegar	2.8
orange juice	3.5
coffee	5.0
milk	6.6



pH of Some Common Bases

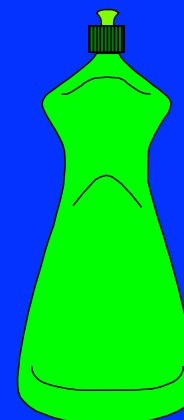
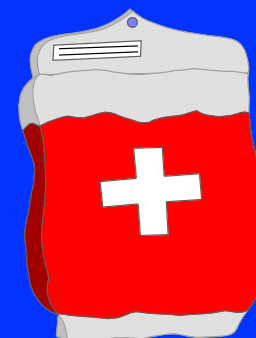
blood 7.4

tears 7.4

seawater 8.4

milk of magnesia 10.6

household ammonia 11.0



Calculating pH Examples

- What is pH of 0.0002M HI solution?

$$\text{pH} = -\log[\text{H}_3\text{O}^+] = -\log(0.0002) = 3.7$$

- What is the pH of 0.0070 M NaOH?

Remember this is a base so :

$$-\log[\text{OH}^-] = -\log(0.0070) = 2.15$$

$$\text{pH} = 14 - 2.15 = 11.85$$

Learning Check AB5

- Calculate the pH of the following:
 - (a) $1 \times 10^{-4}\text{M}$ HCl
 - (b) 0.0025M H_2SO_4
 - (c) 0.0055M NaOH
 - (d) 0.0195M KOH

Learning Check AB5

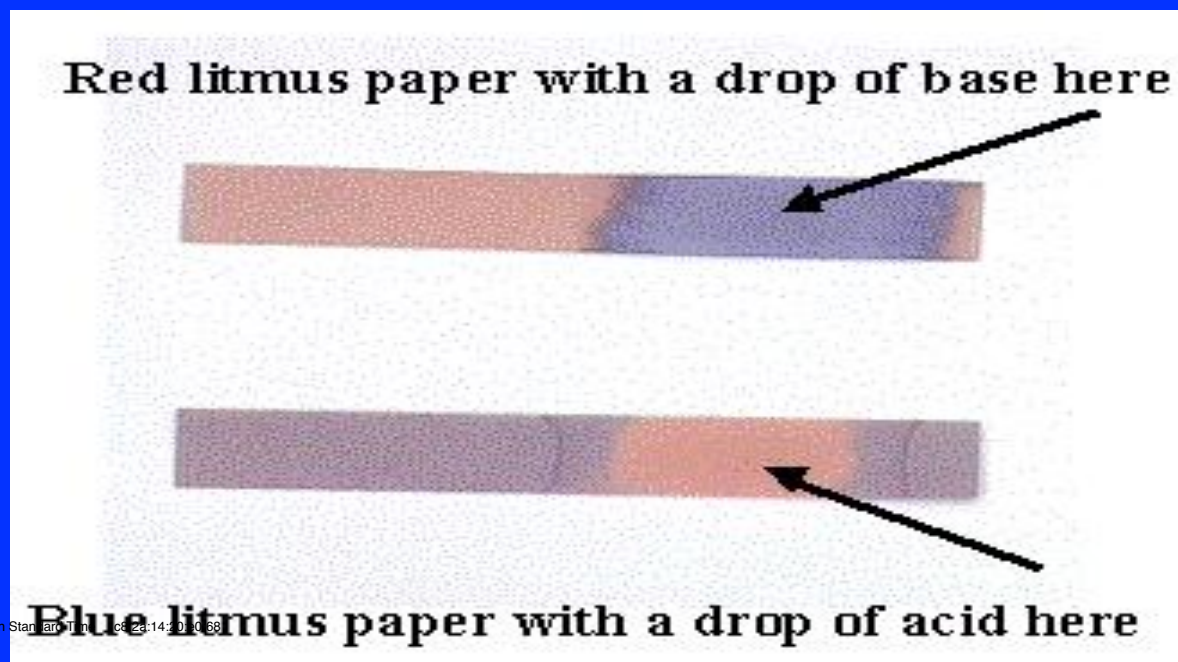
- Calculate the pH of the following:
 - (a) 4
 - (b) 2.6
 - (c) 11.74
 - (d) 12.3

Detecting Acids and Bases

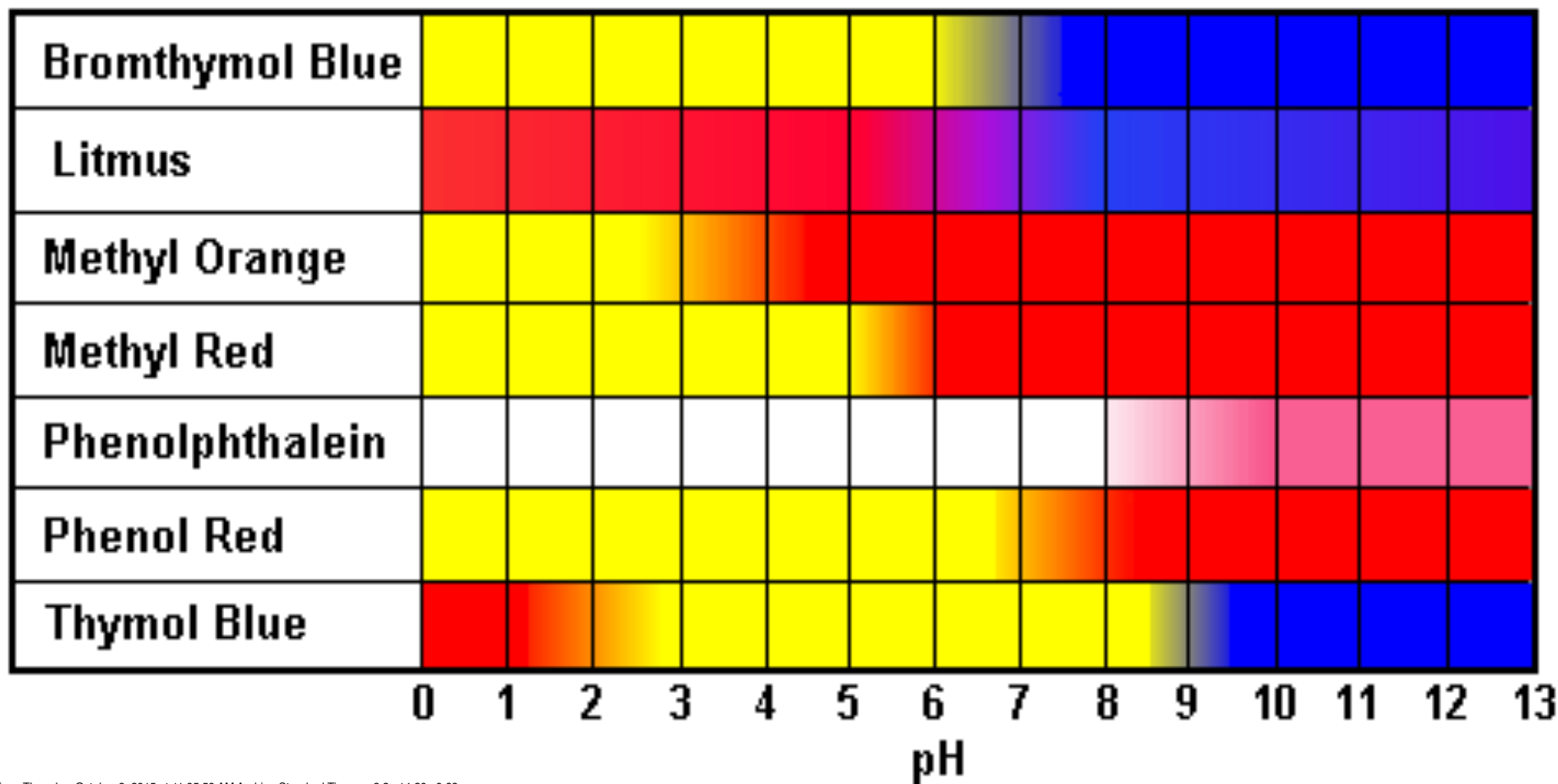
- You can detect an acid using an indicator.
- **INDICATOR** - A substance that changes color in the presence of an acid or a base.

Indicators

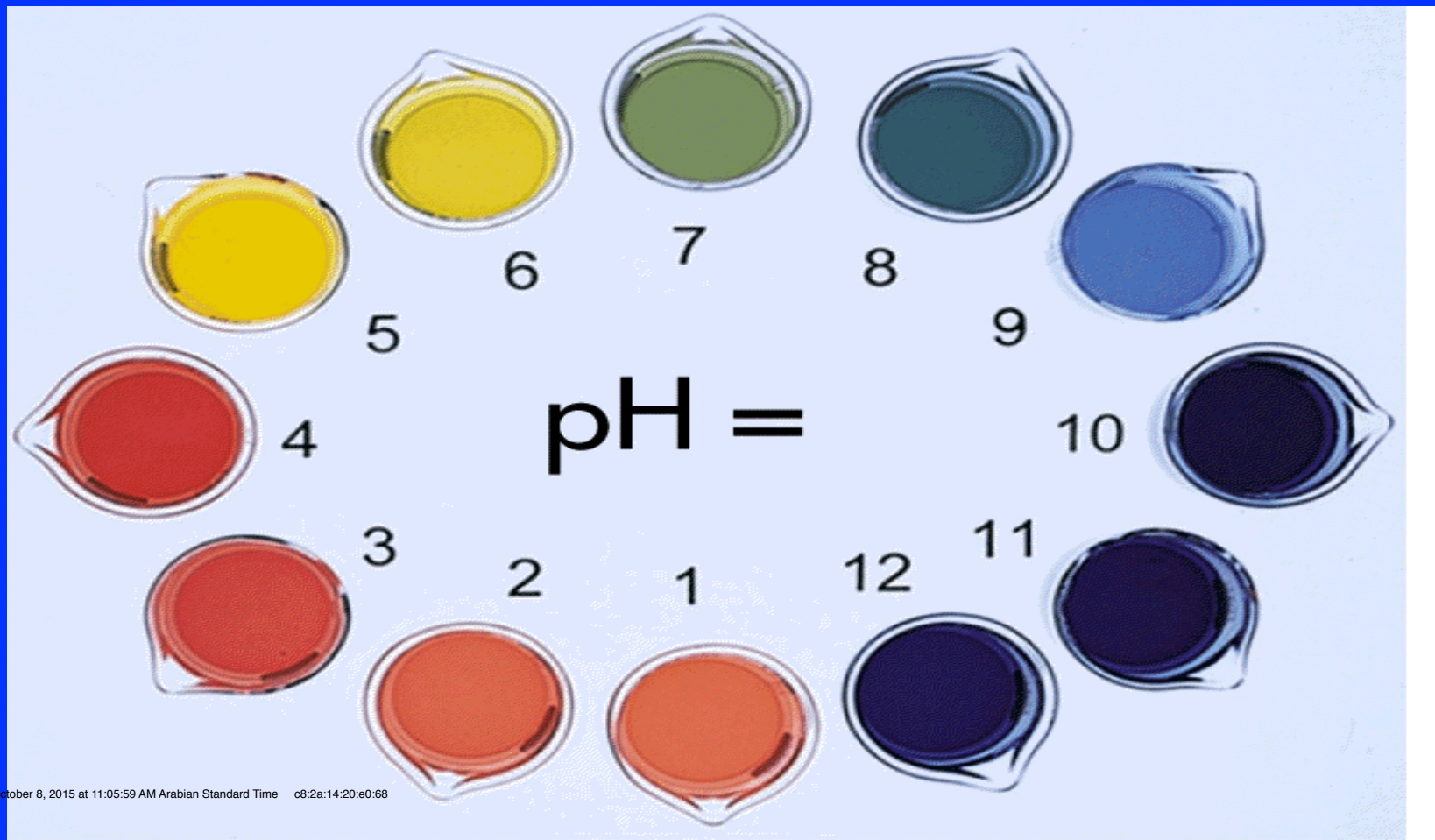
- Litmus paper is an indicator
 - *An acid turns blue litmus paper red*
 - *A base turns red litmus paper blue*



Indicators - Solutions



Universal Indicator



pH meter



Phenolphthalein indicator in Action

- Let's watch!!!

Strengths of Acids and Bases

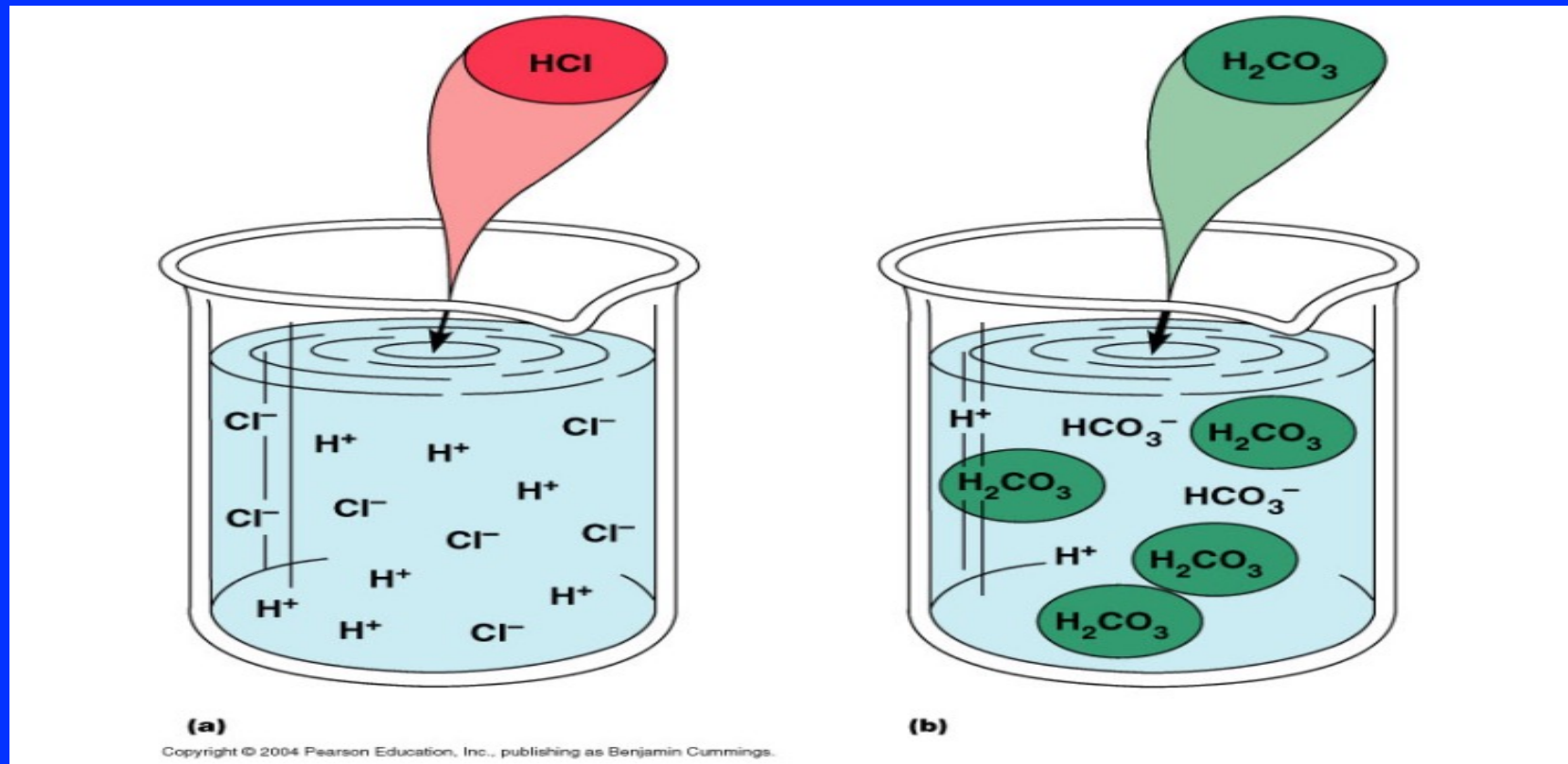
Strong acids completely ionize (100%) in aqueous solutions_____



Strong bases completely (100%) dissociate into ions in aqueous solutions.



Strong VS Weak Acid



Strong and Weak Acids and Bases

Strong acids



Most other acids are weak.

Strong bases



Most other bases are weak.

Learning Check SW1

Identify each of the following as a
1) strong acid or base 2) weak acid
3) weak base

A. ____ HCl (aq)

B. ____ NH₃(aq)

C. ____ NaOH (aq)

D. ____ H₂CO₃ (aq)

Solution SW1

Identify each of the following as a

1) strong acid or base 2) weak acid

3) weak base

A. 1 HCl (aq)

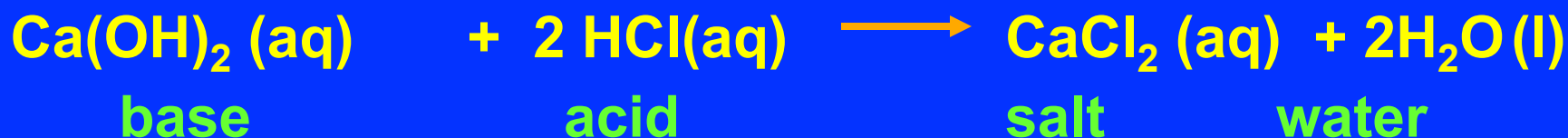
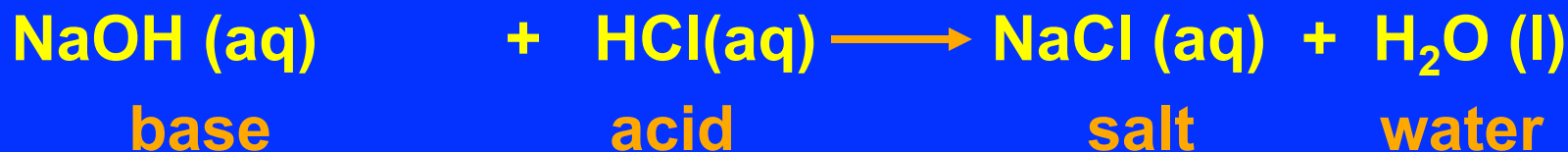
B. 3 NH₃(aq)

C. 1 NaOH (aq)

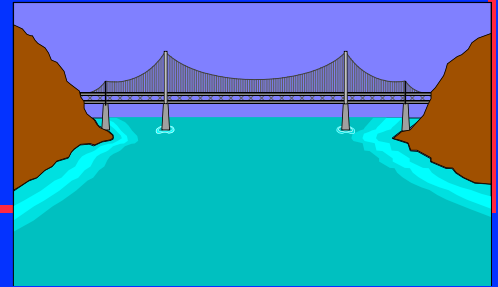
D. 2 H₂CO₃ (aq)

Neutralization Reactions

When acid and bases with equal amounts of hydrogen ion H^+ and hydroxide ions OH^- are mixed, the resulting solution is neutral.



Neutralization



H_3O^+ and OH^- combine to produce water



Naming Salts

Acid	Its salt	Example
Hydrochloric acid, HCl	Chlorides	NaCl
Sulphuric Acid, H ₂ SO ₄	Sulphates	CuSO ₄
Nitric Acid, HNO ₃	Nitrates	KNO ₃

Learning Check AB6

Acid, Base
or Salt

Name











Solution AB6

	Acid, Base or Salt	Name
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Balancing Neutralization Equations

Write the equation for the neutralization between magnesium hydroxide and nitric acid.

1. Write the formulas of the acid and base



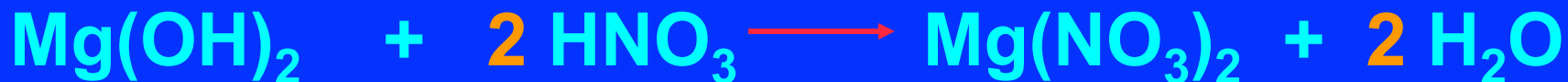
2. Balance to give equal OH^- and H^+



3. Write the products:



4. Balance products



Learning Check N2

Complete and balance following neutralization equations.
Then write the reaction in words.



1) 1, 3, 3, 1

2) 3, 1, 1, 1

3) 3, 1, 1, 3



1) 3, 2, 2, 2

2) 3, 3, 1, 6

3) 2, 3, 1, 6

Learning Check N2

Select the correct group of coefficients for the following neutralization equations



1) 1, 3, 3, 1

2) 3, 1, 1, 1

3) 3, 1, 1, 3



1) 3, 2, 2, 2

2) 3, 3, 1, 6

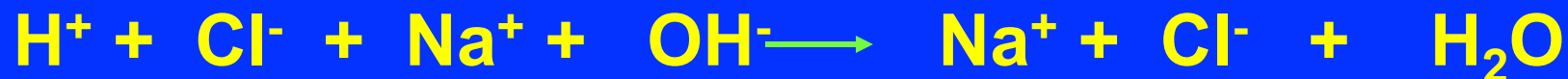
3) 2, 3, 1, 6

Solution N2



Ionic Equations for Neutralization

Write strong acids, bases, and salt as ions



Cross out matched ions



Write a net ionic reaction



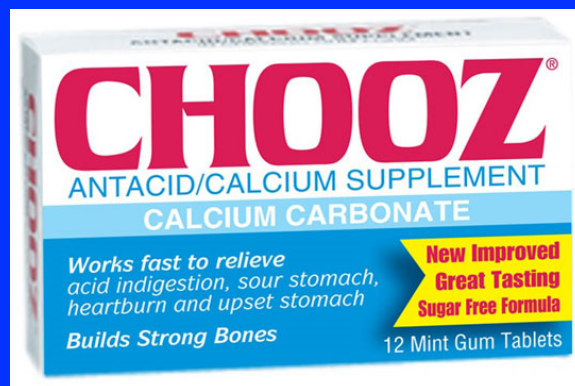
Antacids

- Used to neutralize stomach acid (HCl)
- Many contain one or more weak bases

Milk of Magnesia: $\text{Mg}(\text{OH})_2$

Maalox: $\text{Al}(\text{OH})_3$ and $\text{Mg}(\text{OH})_2$

Mylanta: $\text{Al}(\text{OH})_3$ and $\text{Mg}(\text{OH})_2$



More Acid Reactions

- Acid + carbonate \rightarrow salt + water + carbon dioxide.
- Acid + metal \rightarrow salt + hydrogen
- Look at page 146

Strong acid VS concentrated Acid

- Concentrated acid: very little water
- Strong acid: complete dissociation of acid (strength of pH).
- So we can have concentrated ethanoic acid (acetic acid) which is a weak acid (pH 3) but dilute hydrochloric acid which a strong acid (pH 1)